CLAIMS:

1. A method of monitoring a processing system for processing a substrate during the course of semiconductor manufacturing, comprising:

acquiring data from said processing system for a plurality of observations, said data comprising a plurality of data parameters;

constructing a principal components analysis (PCA) model from said data, including centering coefficients;

acquiring additional data from said processing system, said additional data comprising an additional observation of said plurality of data parameters;

adjusting said centering coefficients to produce updated adaptive centering coefficients for each of said data parameters in said PCA model;

applying said updated adaptive centering coefficients to each of said data parameters in said PCA model;

determining at least one statistical quantity from said additional data using said PCA model;

setting a control limit for said at least one statistical quantity; and

comparing said at least one statistical quantity to said control limit.

2. The method of claim 1, wherein said adjusting said centering coefficients comprises:

updating the adaptive centering coefficient for each data parameter by combining an old value of the adaptive centering coefficient for each data parameter and a current value of each data parameter for said additional observation, wherein said old value comprises a mean value of the data parameter during said plurality of observations.

3. The method of claim 2, wherein said combining said old value of said adaptive centering coefficient and said current value of said data parameter for said additional observation comprises:

applying an exponentially weighted moving average (EWMA) filter.

4. The method of claim 3, wherein said applying said EWMA filter comprises:

setting a weighting factor.

5. The method of claim 4, wherein said setting said weighting factor comprises:

setting said weighting factor to a value ranging from 0.5 to 1.0.

6. The method of claim 5, wherein said setting said weighting factor comprises:

setting said weighting factor to a value ranging from 0.8 to 0.95.

7. The method of claim 1, wherein said applying said updated adaptive centering coefficients to each of said data parameters comprises:

subtracting said updated centering coefficients from each of said data parameters.

8. The method of claim 1, further comprising:

determining scaling coefficients for the PCA model;

adjusting the scaling coefficients to produce updated adaptive scaling coefficients for each of said data parameters in said PCA model; and

applying said updated adaptive scaling coefficients to each of said data parameters in said PCA model.

9. The method of claim 8, wherein said adjusting said scaling coefficients comprises:

applying a recursive standard deviation filter, said filter combining an old value of the adaptive scaling coefficient for each data parameter, a current value of each data parameter for said additional observation, and an old value of the adaptive centering coefficient for each data parameter,

wherein said old value of said adaptive scaling coefficient comprises a standard deviation of said data parameter during said plurality of observations and said old value of said adaptive centering coefficient comprises a mean value of said data parameter during said plurality of observations.

10. The method of claim 9, wherein said applying said recursive standard deviation filter comprises setting a filter constant.

11. The method of claim 1, wherein said applying said updated adaptive scaling coefficients to each of said data parameters comprises dividing each of said data parameters by said updated scaling coefficients.

12. The method of claim 1, wherein said constructing said PCA model comprises:

determining one or more principal components of said data for said plurality of observations using principal components analysis.

13. The method of claim 1, further comprising:

detecting a process fault has occurred when said at least one statistical quantity exceeds said control limit.

14. The method of claim 1, wherein said plurality of data parameters comprises at least one of a capacitor position, a forward radio frequency (RF) power, a reflected RF power, a voltage, a current, a phase, an impedance, a RF peak-to-peak voltage, a RF self-induced direct current bias, a chamber pressure, a gas flow rate, a temperature, a backside gas pressure, a backside gas flow rate, an electrostatic clamp voltage, an electrostatic clamp current, a focus ring thickness, RF hours, a process step duration, focus ring RF hours, an optical emission spectrum, and RF harmonics

15. The method of claim 1, wherein said plurality of data parameters comprises at least one of an instantaneous value, a time average, a standard deviation, a third moment, a fourth moment, and a variance.

16. The method of claim 1, wherein said statistical quantity comprises at least one of a Q-statistic and a Hotelling T^2 parameter.

17. The method of claim 1, further comprising:

accessing at least one of said data, said additional data, said adaptive centering coefficients, said at least one statistical quantity, and said control limit via at least one of an intranet and an internet.

18. The method of claim 8, further comprising:

accessing said adaptive scaling coefficients via at least one of an intranet and an internet.

19. In a principal components analysis (PCA) model for monitoring a processing system for processing a substrate during the course of semiconductor manufacturing, the improvement comprising:

an adaptive centering coefficient for each data parameter during a current observation of a given data parameter,

said adaptive centering coefficient combining an old value of said adaptive centering coefficient and a current value of said data parameter for said current observation, wherein said old value comprises a mean value of the data parameter during a plurality of observations preceding said current observation.

20. The improvement of claim 19, wherein said combining said old value of said adaptive centering coefficient and said current value of said data parameter for said current observation comprises applying an exponentially weighted moving average (EWMA) filter.

21. The improvement of claim 20, wherein said applying said EWMA filter comprises setting a weighting factor.

22. The improvement of claim 21, wherein said setting said weighting factor comprises setting said weighting factor to a value ranging from 0 to 1.

23. The improvement of claim 22, wherein said setting said weighting factor comprises setting said weighting factor to a value ranging from 0.8 to 0.95.

24. The improvement of claim 19, further comprising:

an adaptive scaling coefficient for each data parameter during a current observation of the given data parameter,

said adaptive scaling coefficient comprising application of an exact recursive standard deviation formula, said formula combining an old value of the adaptive scaling coefficient, a current value of each data parameter for said current observation, and an old value of the adaptive centering coefficient,

wherein said old value of said adaptive scaling coefficient comprises a standard deviation of said data parameter during a plurality of observations preceding said current observation and said old value of said adaptive centering coefficient comprises the mean value of said data parameter during a plurality of observations preceding said current observation.

25. A processing system for processing a substrate during the course of semiconductor manufacturing, comprising:

a process tool; and

a process performance monitoring system coupled to said process tool and comprising a plurality of sensors coupled to said process tool and a controller coupled to said plurality of sensors and said process tool,

wherein said controller includes,

means for acquiring data from said plurality of sensors for a plurality of observations, said data comprising a plurality of data parameters,

means for constructing a principal components analysis (PCA) model from said data, including centering coefficients,

means for acquiring additional data from said plurality of sensors,

means for adjusting said centering coefficients to produce updated adapative centering coefficients for each of said data parameters,

means for applying said updated adaptive centering coefficients to each of said data parameters in said PCA model,

means for determining at least one statistical quantity from said additional data using said PCA model,

means for setting a control limit for said at least one statistical quantity, and

means for comparing said at least one statistical quantity to said control limit.

26. The processing system of claim 25, wherein said means for adjusting said centering coefficients comprises:

means for combining an old value of the adaptive centering coefficient for each data parameter and a current value of each data parameter for said additional observation, wherein said old value comprises a mean value of the data parameter during said plurality of observations.

27. The processing system of claim 25, further comprising:

means for determining scaling coefficients for the PCA model;

means for adjusting the scaling coefficients to produce updated adaptive scaling coefficients for each of said data parameters in said PCA model; and

means for applying said updated adaptive scaling coefficients to each of said data parameters in said PCA model.

28. The processing system of claim 27, wherein said means for adjusting said scaling coefficients comprises:

means for applying a recursive standard deviation filter to said adaptive scaling coefficients, said filter combining an old value of the adaptive scaling coefficient for each data parameter, a current value of each data parameter for said additional observation, and an old value of the adaptive centering coefficient for each data parameter,

wherein said old value of said adaptive scaling coefficient comprises a standard deviation of said data parameter during said plurality of observations and said old value of said adaptive centering coefficient comprises a mean value of said data parameter during said plurality of observations.

29. The processing system of claim 25, further comprising:

means for accessing at least one of said data, said additional data, said adaptive centering coefficients, said at least one statistical quantity, and said control limit.

30. The processing system of claim 29, wherein said means for accessing comprises at least one of an intranet and an internet.

31. The processing system of claim 27, further comprising:

means for accessing at least one of said data, said additional data, said adaptive centering coefficients, said adaptive scaling coefficients, said at least one statistical quantity, and said control limit.

32. The processing system of claim 31, wherein said means for accessing comprises at least one of an intranet and an internet.

33. A processing performance monitoring system to monitor a processing system for processing a substrate during the course of semiconductor manufacturing, comprising:

a plurality of sensors coupled to said processing system; and

a controller coupled to said plurality of sensors and said processing system, wherein said controller includes,

means for acquiring data from said plurality of sensors for a plurality of observations, said data comprising a plurality of data variables,

means for acquiring data from said plurality of sensors for a plurality of observations, said data comprising a plurality of data parameters,

means for constructing a principal components analysis (PCA) model from said data, including centering coefficients,

means for acquiring additional data from said plurality of sensors,

means for adjusting said centering coefficients to produce updated centering coefficients for each of said data parameters,

means for applying said updated adaptive centering coefficients to each of said data parameters in said PCA model,

means for determining at least one statistical quantity from said additional data using said PCA model,

means for setting a control limit for said at least one statistical quantity, and

means for comparing said at least one statistical quantity to said control limit.

34. The process performance monitoring system of claim 33, wherein said means for adjusting said centering coefficients comprises:

means for combining an old value of the adaptive centering coefficient for each data parameter and a current value of each data parameter for said additional observation,

wherein said old value comprises a mean value of the data parameter during said plurality of observations.

35. The process performance monitoring system of claim 33, further comprising:

means for determining scaling coefficients for the PCA model;

means for adjusting the scaling coefficients to produce updated adaptive scaling coefficients for each of said data parameters in said PCA model; and

means for applying said updated adaptive scaling coefficients to each of said data parameters in said PCA model.

36. The process performance monitoring system of claim 35, wherein said means for adjusting said scaling coefficients comprises:

means for applying a recursive standard deviation filter to said adaptive scaling coefficients,

said filter combining an old value of the adaptive scaling coefficient for each data parameter, a current value of each data parameter for said additional observation, and an old value of the adaptive centering coefficient for each data parameter,

wherein said old value of said adaptive scaling coefficient comprises a standard deviation of said data parameter during said plurality of observations and said old value of said adaptive centering coefficient comprises a mean value of said data parameter during said plurality of observations.

37. The process performance monitoring system of claim 33, further comprising:

means for accessing at least one of said data, said additional data, said adaptive centering coefficients, said at least one statistical quantity, and said control limit.

38. The process performance monitoring system of claim 37, wherein said means for accessing comprises at least one of an intranet and an internet.

39. The process performance monitoring system of claim 35, further comprising:

means for accessing at least one of said data, said additional data, said adaptive centering coefficients, said adaptive scaling coefficients, said at least one statistical quantity, and said control limit.

40. The process performance monitoring system of claim 39, wherein said means for accessing comprises at least one of an intranet and an internet.

41. A method of monitoring a first processing system for processing a substrate during the course of semiconductor manufacturing, comprising:

acquiring data from a second processing system for a plurality of observations, said data comprising a plurality of data parameters;

constructing a principal components analysis (PCA) model from said data for said second processing system including centering coefficients;

acquiring additional data from said first processing system, said additional data comprises an additional observation of said plurality of data parameters;

adjusting said centering coefficients to produce updated adaptive coefficients for each of said data parameters in said PCA model;

applying said updated adaptive centering coefficients to each of said data parameters in said PCA model;

determining at least one statistical quantity from said additional data using said PCA model;

setting a control limit for said at least one statistical quantity; and

comparing said at least one statistical quantity to said control limit.

42. The method of claim 41, further comprising:

determining scaling coefficients for the PCA model;

adjusting the scaling coefficients to produce updated adaptive scaling coefficients for each of said data parameters in said PCA model; and

applying said updated adaptive scaling coefficients to each of said data parameters in said PCA model.

43. A method for classifying a process fault occurring during a plurality of substrate runs in a processing system, comprising:

monitoring a plurality of data parameters from said processing system for each substrate run within said plurality of substrate runs;

identifying a fault substrate run, within said plurality of substrate runs using multivariate analysis, in which said process fault occurred;

selecting a first substrate run preceding said fault substrate run;

calculating a first plurality of mean values for each of said plurality of data parameters during said first substrate run;

selecting a second substrate run following said fault substrate run;

calculating a second plurality of mean values for each of said plurality of data parameters during said second substrate run;

determining an absolute value of a plurality of differences between said second plurality of mean values and said first plurality of mean values for each of said plurality of data parameters;

calculating a plurality of standard deviations for each of said plurality of data parameters during at least one of said first substrate run and said second substrate run;

normalizing said plurality of differences by said plurality of standard deviations for each of said plurality of data parameters;

determining the largest value of said normalized differences; and

identifying the data parameter amongst said plurality of data parameters corresponding to said largest value of said differences.

44. The method of claim 43, wherein said calculating each of said first plurality of mean values for each of said plurality of data parameters during said first substrate run comprises:

combining a first old mean value for each data parameter and a current value of each data parameter for said first substrate run,

wherein said first old mean value comprises a mean value of the data parameter during a substrate run preceding said first substrate run, and said calculating each of said second plurality of mean values for each of said plurality of data parameters during said second substrate run comprises combining a second old mean value for each data parameter and a current value of each data parameter for said second substrate run,

wherein said second old mean value comprises a mean value of the data parameter during a substrate run preceding said second substrate run.

45. The method of claim 44, wherein said combining said first old mean value and said current value of said data parameter during said first substrate run and said combining said second old mean value and said current value of said data parameter during said second substrate run comprises:

applying an exponentially weighted moving average (EWMA) filter.

46. A method for classifying a process fault occurring during a plurality of substrate runs in a processing system, comprising:

monitoring a plurality of data parameters from said processing system for each substrate run within said plurality of substrate runs;

identifying a fault substrate run, within said plurality of substrate runs using multivariate analysis, in which said process fault occurred;

selecting a first substrate run preceding said fault substrate run;

calculating a first plurality of standard deviations for each of said plurality of data parameters during said first substrate run;

selecting a second substrate run following said fault substrate run;

calculating a second plurality of standard deviations for each of said plurality of data parameters during said second substrate run;

determining an absolute value of a plurality of differences between said second plurality of standard deviations and said first plurality of standard deviations for each of said plurality of data parameters;

calculating a plurality of mean values for each of said plurality of data parameters during one of said first substrate run and said second substrate run;

normalizing said plurality of differences by said plurality of mean values for each of said plurality of data parameters;

determining the largest value of said normalized differences; and

identifying the data parameter amongst said plurality of data parameters corresponding to said largest value of said differences.

47. A computer readable medium containing program instructions for execution on a computer system, which when executed by the computer system, cause the computer system to perform the steps of

acquiring data from a processing system for a plurality of observations, said data comprising a plurality of data parameters;

constructing a principal components analysis (PCA) model from said data, including centering coefficients;

acquiring additional data from said processing system, said additional data comprising an additional observation of said plurality of data parameters;

adjusting said centering coefficients to produce updated adaptive centering coefficients for each of said data parameters in said PCA model;

applying said updated adaptive centering coefficients to each of said data parameters in said PCA model;

determining at least one statistical quantity from said additional data using said PCA model;

setting a control limit for said at least one statistical quantity; and

comparing said at least one statistical quantity to said control limit.

48. A computer readable medium containing program instructions for execution on a computer system, which when executed by the computer system, cause the computer system to perform the steps of:

acquiring data from a second processing system for a plurality of observations, said data comprising a plurality of data parameters;

constructing a principal components analysis (PCA) model from said data for said second processing system, including centering coefficients;

acquiring additional data from a first processing system, said additional data comprises an additional observation of said plurality of data parameters;

adjusting said centering coefficients to produce updated adaptive centering coefficients for each of said data parameters in said PCA model;

applying said updated adaptive centering coefficients to each of said data parameters in said PCA model;

determining at least one statistical quantity from said additional data using said PCA model;

setting a control limit for said at least one statistical quantity; and

comparing said at least one statistical quantity to said control limit.

49. A computer readable medium containing program instructions for execution on a computer system, which when executed by the computer system, cause the computer system to perform the steps of:

monitoring a plurality of data parameters from a processing system for each substrate run within said plurality of substrate runs;

identifying a fault substrate run, within said plurality of substrate runs using multivariate analysis, in which said process fault occurred;

selecting a first substrate run preceding said fault substrate run;

calculating a first plurality of mean values for each of said plurality of data parameters during said first substrate run;

selecting a second substrate run following said fault substrate run;

calculating a second plurality of mean values for each of said plurality of data parameters during said second substrate run;

determining an absolute value of a plurality of differences between said second plurality of mean values and said first plurality of mean values for each of said plurality of data parameters;

calculating a plurality of standard deviations for each of said plurality of data parameters during at least one of said first substrate run and said second substrate run;

normalizing said plurality of differences by said plurality of standard deviations for each of said plurality of data parameters;

determining the largest value of said normalized differences; and

identifying the data parameter amongst said plurality of data parameters corresponding to said largest value of said differences.

50. A computer readable medium containing program instructions for execution on a computer system, which when executed by the computer system, cause the computer system to perform the steps of:

monitoring a plurality of data parameters from said processing system for each substrate run within said plurality of substrate runs;

identifying a fault substrate run, within said plurality of substrate runs using multivariate analysis, in which said process fault occurred;

selecting a first substrate run preceding said fault substrate run;

calculating a first plurality of standard deviations for each of said plurality of data parameters during said first substrate run;

selecting a second substrate run following said fault substrate run;

calculating a second plurality of standard deviations for each of said plurality of data parameters during said second substrate run;

determining the absolute value of a plurality of differences between said second plurality of standard deviations and said first plurality of standard deviations for each of said plurality of data parameters;

calculating a plurality of mean values for each of said plurality of data parameters during one of said first substrate run and said second substrate run;

normalizing said plurality of differences by said plurality of mean values for each of said plurality of data parameters;

determining the largest value of said normalized differences; and

identifying the data parameter amongst said plurality of data parameters corresponding to said largest value of said differences.